

Searching, Finding, Reading, Understanding, and The Challenges of Using Mars Mission Datasets for Science Analysis

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The “customer perspective”



- **Who are the customers (users) of mission data?**

- Funded R&A PIs, Co-Is, Grad students, post-docs
- Mission planners
- Scientists interested in proposing to use the data for R&A programs

- **What are their goals?**

- Detailed analyses
 - begin with raw data, calibrate it themselves, accurately correlate with surface features, other data sets, incorporate custom algorithms, etc.
- Simple answers
 - does appropriate data exist for the region of interest?
 - what are standard characteristics of region of interest (altimetry, radiometry, composition...)

At first glance the data sets are overwhelming...



- **Mariner, Viking (lander, orbiter), Hubble**
- Mars Pathfinder: IMP, APXS, ASI/MET
- **Mars Global Surveyor: MOC, TES, MOLA, MAG/ER**
- Mars Odyssey: THEMIS, GRS, NS, MARIE, HEND
- **Mars Express: HRSC, OMEGA, MARSIS/ASPERA/SPICAM**
- Mars Exploration Rovers: Pancam, Mini-TES, MB, APXS, MI, RAT, Navcam, Hazcam
- **Mars Reconnaissance Orbiter: HiRISE, CRISM, CTX, MARCI, MCS, SHARAD**
- *Phoenix: RAD, MARDI, SSI, TEGA, MECA, MET*
- **Mars Science Laboratory: MastCam, MARDI, MAHLI, ChemCam, APXS, CheMin, SAM, DAN, RAD, REMS**

Where's the data? Get thee to a PDS website....

<http://pds.jpl.nasa.gov/>

April 20, 2006



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Planetary Data System

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what you're
looking for?

The Planetary Data System (PDS)
The PDS archives and distributes scientific data from NASA planetary missions, astronomical observations, and laboratory measurements. The PDS is sponsored by NASA's Office of Space Science. Its purpose is to ensure the long-term usability of NASA data and to stimulate advanced research. PDS is continually upgrading and updating its archives, to better serve the needs of its user communities. [Learn more about PDS.](#)

PDS Nodes - The Best of Planetary Data!
The PDS includes seven university/research center science teams, called discipline nodes. These nodes specialize in specific areas of planetary data. The contributions from these nodes provide a data-rich source for scientists, researchers and developers. You can visit them through the links on the PDS Nodes navigation bar, below. You will learn more about the archives of each node, and about the education and public outreach services that these nodes provide.

**2006 ROSES DAP**
[Cassini DAP \(Atmospheres Node\)](#)
[Cassini DAP \(Rings Node\)](#)
[Discovery DAP \(Small Bodies Node\)](#)

**NEW RELEASES**
[PDS Tools Package: March 23, 2006](#)
[Mars Odyssey Radio Science Release #45 March 14, 2006](#)
[PDS Data Dictionary: March 07, 2006](#)

Please go to "[PDS Data Release Summary](#)" for a complete list of releases

begin here...
Data Search

Information for Proposers


How to Search

**Planetary
Photojournal**

ManagementAtmospheresGeosciencesImagingNAIFPPIRingsSmall BodiesEngineering

Or the Imaging Node....
<http://pds-imaging.jpl.nasa.gov/>







PDS Imaging Node

U.S. Geological Survey Jet Propulsion Laboratory


RESOURCES ABOUT PDS IMAGING NODE FEEDBACK SITEMAP HELP

New Users

Can't find what you're looking for?



Planetary Photojournal



Planetary Image Atlas



Map a Planet




Data Release Calendar

Welcome to the PDS Imaging Node

The Imaging Node of the Planetary Data System is the curator of NASA's primary digital image collections from past, present and future planetary missions. The node provides to the NASA planetary science community the digital image archives, necessary ancillary data sets, software tools, and technical expertise necessary to fully utilize the vast collection of digital planetary imagery.

Image of the Week:

Smokin' Hot Galaxy



[PIA02917: Full Resolution and Caption of NASA's Spitzer Space Telescope \(SST\)](#)

This infrared image from NASA's Spitzer Space Telescope shows a galaxy that appears to be sizzling hot, with huge plumes of smoke swirling around it. The galaxy, known as Messier 82 or the "Cigar galaxy," is in fact, smothered in smoky dust particles (red) blown out into space by the galaxy's hot stars (blue).

Latest News

Mars Exploration Rover MER Release No. 7

February 7, 2006: The seventh Mars Exploration Rover (MER) data release occurred including data acquired between Sols 451-540; the data may be accessed via the PDS Data Release Calendar or via the [Planetary Image Atlas](#).

Cassini Release No. 3

January 3, 2006: The second Cassini VIMS, ISS, and Radar release is now available. The data may be accessed via the [PDS Imaging Node Atlas](#).

Mars Odyssey Release No. 14

January 3, 2006: The fourteenth Mars Odyssey data release occurred. THEMIS and GRS data may be accessed by clicking [here](#).

Mars Global Surveyor MOC Release No. 11

October 26, 2005: The eleventh Mars Global Surveyor (MGS) MOC data release occurred including data acquired between October 1, 2004 and March 31, 2005; the data may be accessed by clicking [here](#).

[News Archives>>](#)


PDS Atmospheres Engineering **Geosciences** Imaging NAIF PPI Rings Small Bodies Management

April 20, 2006

Or the Geosciences Node....


<http://pds-geosciences.wustl.edu/>





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PDS Geosciences Node

Washington University in St. Louis

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Quick Links

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Welcome to the Geosciences Node

The Geosciences Node of NASA's [Planetary Data System](#) (PDS) archives and distributes digital data related to the study of the surfaces and interiors of terrestrial planetary bodies. We work directly with NASA missions to help them generate well-documented, permanent data archives. We provide data to NASA-sponsored researchers upon request, along with expert assistance in using the data. Our focus is mainly on serving the planetary science community, but we also provide some support for the general user interested in geoscience data.

Where's the Data?

Click on **DATA AND SERVICES** in the black navigation bar above to browse our data holdings.

The Geosciences Node is part of the [Earth and Planetary Remote Sensing Laboratory](#) in the [Department of Earth and Planetary Sciences](#) at

 Washington University in St. Louis

What's New

March 22, 2006. New [Odyssey Radio Science](#) data are posted.

March 11, 2006. New [Odyssey Radio Science](#) data are posted.

March 10, 2006. The [MRO CRISM Spectral Library](#) has been delivered to PDS and is now undergoing peer review.


Feb. 24, 2006. Revised [Magellan gravity and topography models](#) of Venus are now available.

Feb. 22, 2006. [MER MB derived data](#) are in an article published in [JGR Planets](#).


Feb. 13, 2006. New [MGS TES data](#) have been released.

[What's Old](#)

PDS Nodes:	PDS	Atmospheres	Geosciences	Imaging	NAIF	PPI	Rings	Small Bodies
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+ Freedom of Information Act
+ NASA 2003 Strategic Plan
+ NASA Privacy Statement, Disclaimer, and Accessibility Certification
+ Copyright/Image Use Policy



Curator: [Susan Slavney](#)
NASA Official: [Raymond E. Arvidson](#)
Last Updated: 22 Mar 2006
+ [Comments and Questions](#)

April 20, 2006

Typical end-user complaints about mission data products (L. Crumpler):



- **The released data cannot be “used” easily by non-mission scientists:**

- Searches are stymied by data format challenges
- Data are too “raw” to be useful....
 - data are organized/archived along mission timelines/orbits instead of spatial location
 - ...Or data are too highly processed (gridded, resampled) for users who wish to analyze “actual observations”
- **“Quick look” overviews of available data for particular regions require substantial time commitments**
 - MOLA: “There is not an easy way to find the right track, so a lot of time can be spent downloading a track that turns out to be not the one that is needed.”

But there are **lots** of tools out there to locate and/or process data....



- **MOC**

- MS³: http://www.msss.com/moc_gallery/
- USGS: <http://ida.wr.usgs.gov/>

- **THEMIS**

- ASU---THMPROC <http://themis.asu.edu/> → <http://themis.asu.edu/thmproc>

- **MER: Analyst's Notebook:** <http://anserver1.eprsl.wustl.edu/>

- **Combined orbital data sets**

- USGS---PIGWAD: <http://webgis.wr.usgs.gov>
- ASU---JMARS: <http://jmars.asu.edu/>
- Ames---MARSOWEB: <http://marsoweb.nas.nasa.gov/>
- USGS---ISIS (map projections), UPC: <http://isis.astrogeology.usgs.gov/>
- USGS---Map-a-Planet: <http://pdsmaps.wr.usgs.gov/maps.html>

Where's the software?



- **The increasing complexity of Mars datasets results in custom software (s/w) development by instrument teams that is often the only means to visualize/analyze data**

- This s/w may be released at end of mission (but not always)
- This s/w may be well documented/supported and available for a variety of platforms (but not always)
 - ISIS provides support for some (but not yet all) missions/data sets
- Instrument/mission team s/w may require other proprietary tools to execute (e.g., IDL), but not always
 - Use of “virtual” IDL allows s/w use, but limited production ability (?)
- Lack of this s/w results in redundant/complementary efforts to write tools necessary to visualize/analyze data

What's the problem?



• Argument Style 1

- Mars state-of-the-art instruments (remote sensing, in-situ) produce unique datasets that are complicated. But there are lots of smart folks around who can deal with it.
- Tools exist (or are in continuous development by missions and/or R&A folks) to search, quality-check, calibrate, spatially locate, and analyze many data sets.
- If not, instrument documentation is always available to inform users how to work with the data.
- Users need do their homework and learn how to work with complicated data sets.



What's the problem?

- **Argument Style 2 (*more productive*)**

- Complicated datasets have significant “learning curves” that limit effective and efficient use of the data to only the original instrument PI’s team and/or mission teams.
- This inhibits widespread community involvement in understanding/interpreting datasets vital to our understanding of Mars and the future of the Mars Exploration Program.
- These “roadblocks” cause some potential researchers to forego proposals to R&A, Participating Scientist programs



- “I thought about writing a proposal, but I didn’t have the time to become sufficiently fluent in all the datasets, so I bailed....”

So what are the solutions? (1)



- **Continue efforts toward synergizing data from multiple missions and making the data, s/w, derived products available in standardized, easily-accessible formats**

- Expand/connect GIS-related servers
 - JMARS, PIGWAD, JPL, Google?
 - cf. Report of the Mars Environmental GIS Workshop, Oct. 5-6, 2005
- Continue to advertise new tools via DPS/EGS/AGU/LPSC abstracts
- Fund instrument teams to conduct workshops (on-line or in-person) for their instruments and datasets. It's E/PO!
 - TES, THEMIS have done this, others?
 - JMARS, ISIS already do this, too.

So what's the solution? (2)



- **Encourage release of “lite” versions of mission-related software prior to end-of-mission**
 - Mainly for “quick-look” use, not necessarily detailed analysis
 - Curtail necessity of proprietary (expensive) s/w packages → IDLV?
- **Missions need to have a cartographic planning component, and they should follow a consistent cartographic coordinate system and data format**
- **Planetary image data should be systematically processed in a coordinated way and made available in an easily accessed form (e.g., a GIS).**
- **But relatively small budgets permit only partial solutions – need to encourage increased funding.**



Report from Break-out Group #2: IT Considerations

Promote Dataset Synergy (aka PDS)

Report of the Mars Environmental GIS Workshop, Oct. 5-6, 2005

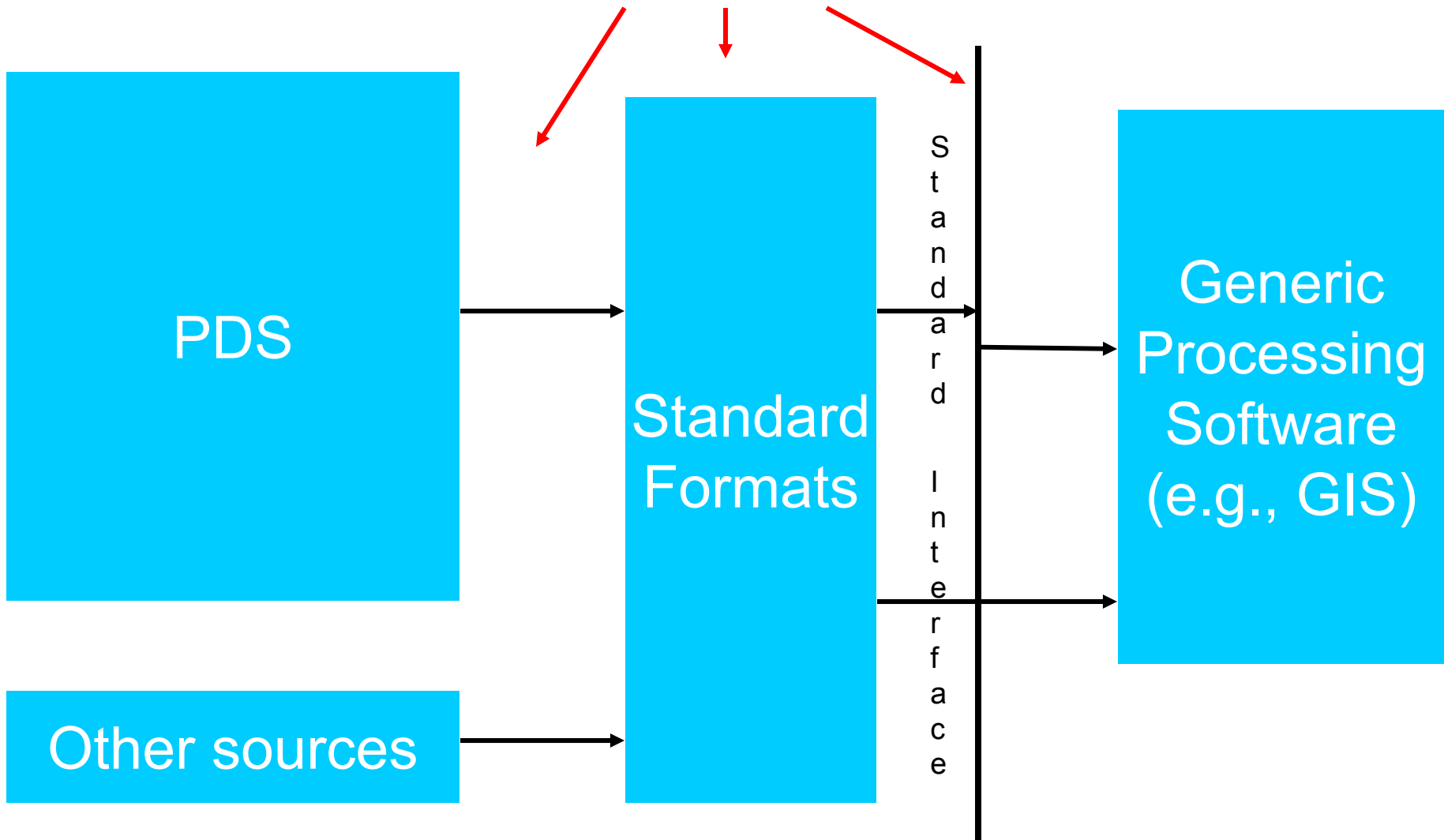
<http://mepag.jpl.nasa.gov/workshop/> (Dave Beaty)

- “GIS-ready” data that are easily used by researchers for display and analysis via Planetary Data Systems (PDS) or other
- Better defined processing steps for commonly used/requested data sets
- Easier tools/capabilities for processing raw data from each instrument into standard format(s)
- Provide validated/calibrated data in both raw and map projected formats
- Need improved data catalog / discovery capability whether the datasets reside at a centralized entity or individual research facility



System Architecture

Need to identify / define / develop these components





Report from Break-out Group #2: IT Considerations

GIS Recommendations (cont)

Report of the Mars Environmental GIS Workshop, Oct. 5-6, 2005

- Provide “on-line services” to help process datasets that are not easily derived as a single final product (e.g., MOC narrow angle, THEMIS visible images).
- Work with future mission planners to “task” instruments and define processing steps to meet geodetic standards
- Develop outreach activities to educate the planetary community about the benefits of:
 - GIS software* for spatial analyses
 - Community-supported data formats

• *i.e., geospatial applications in general, preferably those that can share datasets

• *"One application will simply not work for everyone."* The goal is to standardize the formats and/or data distribution mechanisms to allow many applications to utilize the same data in different ways. ---*Trent Hare*